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A review on herbal Ayurvedic medicinal plants and its association with memory functions

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ABSTRACT

Alzheimer's disease (AD) is a complex, multifactorial, progressive, neurodegenerative disease mainly affecting the elder population. The impairment of central acetylcholine (ACh) neurotransmission due to neural degeneration is believed to be a principal neuropathological feature of AD. In the history Rasayana remedies widely used in Ayurveda for the management of memory impairment. Memory is a vital part of cognition. In health promotive ayurveda is gaining greater attention and popularity in various regions of the world. It is one of the renowned systems of medicine invented from Vedas. The present study is therefore focussed on discussing the various herbal ayurvedic medicinal plants and its association with memory functions.

Keywords: Alzheimer's disease, Rasayana, Medicinal plants, Learning, Memory.

INTRODUCTION

The health promotive, disease preventive and innovation approach available in the Indian systems of prescription like 'Ayurveda' is gaining greater attention and popularity in various regions of the world. Ayurveda is one of the renowned systems of medicine invented from 'Vedas'. Ancient ayurveda physicians has classified 'Ayurveda' in eight divisions by specifying the meaning of each one like 'Kaya chikitsa' (General medicine), 'Tantra' (Surgery), 'Shalaya Tantra' (disease of eye, ear, nose and throat), 'Kumarbhritya' (children diseases, obstetrics and gynecology), 'Agada Tantra' (Toxicology), 'Bhuta Vidya' (Psychiatry), 'Vaji Karana' (Aphrodisiac/sexology) and 'Rasayana' (rejuvenation) [charak ayurveda] ^[1]. Learning is the progression of acquiring information about the world and memory is the retaining of the acquired knowledge which can be regained as and when required ^[2]. Memory is a vital part of Cognition for which the brain plays interesting games of neurotransmitter with billions of neurons. Different forms of memory are associated with different parts of the brain. For example; Short term memory is associated with prefrontal cortex, Long term memory occurs in hippocampus and temporary lobe and skill memory processed in cerebellum ^[3]. The disturbance in such area indications to amnesia and hence memory loss ^[4].

Alzheimer's disease (AD) is a complex, multifactorial, progressive, neurodegenerative disease mainly affecting the elder population and is probable to description for 50-60% of dementia cases in persons over 65 years of age ^[5, 6]. The impairment of central acetylcholine (ACh) neurotransmission due to neural degeneration is believed to be a principal neuropathological feature of Alzheimer's disease ^[7, 8]. Many causal reasons appear to be involved in sporadic AD, including aging ^[9], mitochondrial defects ^[10], insulin dependent diabetes ^[11,12], environmental conditions ^[13] and diet ^[14, 15]. In familial AD, genetic mutations accelerate the disease process ^[9]. Herbal medicine offers numerous possibilities to modify the progress and symptoms of AD. There has been a new trend in the preparation and marketing of drugs based on medicinal plants and their scientific and commercial significance seems to be congregation momentum in health pertinent areas. These plant derivative products are carefully standardized and their efficacy and safety for an exact application have been demonstrated ^[16-20]. The 'Rasayana chikitsa' has got ample popularity among all above mentioned. In the history of ancient medicine system, the eventual tonic preparations were known as 'Rasayana'. 'Rasayana' remedy is a measure to prevent diseases and counteract the aging progression probably by means of optimization or homeostasis. Number of plants i.e. Mandookparni (*Centella asiatica*), Shankhpushpi (*Convolvulus pluricaulis*), Madhuyesthi (*Glycyrrhiza glabra*), Guduchi (*Tinospora cordifolia*) and Brahmi (*Bacopa monnieri*) etc. has been widely used as 'Rasayana' remedies in 'Ayurveda' for the management of memory impairment ^[21]. The present study is therefore focussed on discussing the various herbal ayurvedic medicinal plants and its association with memory functions.

MEDICINAL PLANTS TO IMPROVE MEMORY FUNCTIONS

***Bacopa monnieri* (Scrophulariaceae)**

Bacopa monnieri contains sterols, saponins, alkaloids, monnierin, hersaponin acid A, herpestine and brahmine [22]. The efficacy of *B. monnieri* on cognitive performance, anxiety and depression in the elderly and found effective in enhancing cognitive functions in the elderly [23]. This study justifies its use as a memory enhancer. Another study demonstrated that *B. monnieri* inhibits cholinergic degeneration and exhibits cognition enhancing activity in a rat model of AD [24].

***Evolvulus alsinoides* (Convolvulaceae)**

The efficacy of *Evolvulus alsinoides* in learning behavior and memory enhancement activity in rodents. Nootropic activity of extract was compared with piracetam as the standard drug. Extract of *E. alsinoides* showed significant memory enhancing activity in the step-down and shuttle-box avoidance paradigms [25].

***Convolvulus pluricaulis* (Convolvulaceae)**

The ethanolic extract of *Convolvulus pluricaulis* and its aqueous and ethyl acetate fractions significantly improved memory retention and learning abilities in rats [26]. Administration of *C. pluricaulis* for 1 week increased memory in aged mice [27].

***Withania somnifera* (Solanaceae)**

Withania somnifera (500mg/d) exhibited calming effects on stress and reversed memory loss [28]. Cholinergic activity of *W. somnifera* has been reported in a previous study [29].

***Curcuma longa* L. (Zingiberaceae)**

Curcuma longa has anti-inflammatory and antioxidant activities and it helps in combating Alzheimer's disease (AD). Regular consumption of this herb helps in keeping the mind balanced [30].

***Ginkgo biloba* L. (Ginkgoaceae)**

Ginkgo biloba extracts showed therapeutic benefits in Alzheimer's, similar to prescription drugs such as Donepezil, with minimal undesirable side effects [31]. The chief chemical constituent of *G. biloba* is ginkgolides and it is a pertinent antioxidant, with neuroprotective and cholinergic activities that help in the management of AD [32].

***Panax ginseng* (Araliaceae)**

Panax ginseng contains Saponin. Its saponin shows memory enhancing property on memory impairment induced by scopolamine [33]. Ginseng root improve learning ability in animals [34]. A component of Ginseng saponin, improves the cyproheptadine induced recognition deficits in rats [35].

***Lepidium meyenii* (Brassicaceae)**

Lepidium meyenii shows memory enhancing property on memory impairment in dementia patients [36]. It will be degraded by AChE and this inhibited by this memory enhancing agent [37].

***Acorus Calamus* (Araceae)**

Acorus calamus on improvement of learning and memory showed that oral and intraperitoneal administration of the extract in higher dose could have increase spatial recognition and recalling the data [38].

***Allium sativum* (Alliaceae)**

Allium sativum extract showed that long-term administration may improve learning and memory in mice while the underlying mechanism of action may be attributed to the anti-Acetylcholine Esterase (AChE) activity and anti-oxidant property of garlic [39].

***Curcuma longa* (Zingiberaceae)**

AD symptoms characterized by inflammation and oxidation were also eased by *Curcuma longa* powerful antioxidant and anti-inflammatory properties [40]. Larger controlled trials are needed to determine whether oral *C. longa* supplementation is efficacious in AD [41].

***Centella asiatica* (Apiaceae)**

Centella asiatica is one of the important rejuvenating herbs for nerve and brain cells and is believed to be capable of increasing intelligence, longevity and memory [42]. Its extracts reversed the beta-amyloid pathology in the brains of PSAPP (APP/Swx PS1M146L) mice and modulated the components of the oxidative stress response [43, 44].

***Anacyclus pyrethrum* (Compositae)**

Anacyclus pyrethrum has been recommended for improving memory in traditional medicine. Pre-treatment with the extract of *A. pyrethrum* roots (250 and 500 mg/kg) showed antiepileptic effect and also showed protection against cognitive impairment by decreasing oxidative stress and rho kinase ROCK II expression in pentylenetetrazol kindled mice [45].

***Boswellia species* (Bursaceae)**

The gum resin of *Boswellia species* recommended for enhancing memory and treatment of amnesia in traditional texts. The effect of *Boswellia* gum resin on memory and learning of rat newborns was investigated in numerous studies [46].

***Cyperus rotundus* (Cyperaceae)**

Effect of ethanolic extract of *Cyperus rotundus* root (100, 200 mg/kg) on midazolam induced acute memory loss revealed that this extract significantly decreases the transfer latency in EPM which measures the increase in memory at the time of retrieval and therefore *C. rotundus* shows significant nootropic activity on retrieval and non significant on consolidation [47].

***Zingiber officinalis* (Zingiberaceae)**

Effect of alcoholic extract of *Zingiber officinalis* in rats showed that cognitive function and neurons density in hippocampus of rats receiving *Z. officinalis* extract were improved while the brain infarct volume was decreased. Indeed, it reduced cognitive deficits induced by focal cerebral Ischemia [48].

***Santalum album* (Santalaceae)**

Effect of aqueous extract of *Santalum album* increase the level of acetyl cholinesterase helpful in the brain for storing the memory and so it has a memory enhancing property in mice [49].

***Salvia officinalis* (Labiataeae)**

Salvia officinalis had a reputation of memory enhancement as well as popular Ayurvedic medicine for emotional disturbances and promoting calmness and clarity [50].

***Huperzia serrata* (Lycopodiaceae)**

Plant cholinesterase inhibitor Huperzine derived from Chinese moss *Huperzia serrata*, which was traditionally used to treat inflammation and fever, is also helpful in AD therapy in China [51].

***Ricinus communis* (Euphorbiaceae)**

Ricinine an alkaloid obtained from extract of pericarp of castor bean i.e. *Ricinus communis* has shown memory enhancing property [52].

***Sesamum indicum* (Pedaliaceae)**

Synergistic herbal formulation of *Sesamum indicum* as a brain tonic, cognition, recalling of thoughts and as an antioxidant capable of treating amnesia and having property for improving memory [53].

***Emblica officinalis* (Euphorbiaceae)**

Emblica officinalis possess memory enhancing action on improvement in memory in scopolamine and diazepam induced memory deficits. It inhibits the AChE activity [54].

***Coriandrum sativum* (Apiaceae)**

Coriandrum sativum was given for 45 days for its efficacy on cognitive function in male Wistar rats. This study was conducted in comparison with aging, scopolamine and diazepam induced amnesia. *C. Sativum* exhibited memory enhancing effects due to its antioxidant, anti-inflammatory and cholesterol lowering activities [55].

***Ficus carica* (Moraceae)**

Ficus carica contains quercetin that plays an important role in memory deficit and AD due to its antioxidant activity. For this study, mice with memory deficit and normal mice were used. Rectangular maze model and Y-maze were used to assess efficacy of *F. carica* on cognitive functions [56].

***Ficus racemosa* (Moraceae)**

Ficus racemosa (250 and 500 mg/kg) significantly increased acetylcholine level in the hippocampus of rats. This study suggests its potential to treat memory deficits in patients with AD [57].

***Myristica fragrans* (Myristicaceae)**

N-hexane extract of *Myristica fragrans* at three dose levels (5, 10 and 20 mg/kg p.o.) was administered orally to young and aged mice for 3 successive days. This drug was found effective at 5 mg/kg in

reversing scopolamine and diazepam induced impairment in learning and memory. This study validated use of *M. fragrans* in the management of AD and memory deficits [58].

***Melissa officinalis* L. (Lamiaceae)**

Melissa officinalis temporarily improve cognitive decline as well as improve the mood for Alzheimer's patients. *M. officinalis* is one of several plants that may be useful in the prevention and treatment of AD due to its ability to inhibit acetylcholinesterase and its antioxidant activity [59].

***Commiphora whighitti* (Burseraceae)**

Commiphora whighitti acts on impairment in learning and memory and decreased choline acetyl transferase levels in hippocampus. However, *C. whighitti* shows maximum effects on memory functions and the potential for dementia disorder [60].

***Ilex paraguariensis* (Aquifoliaceae)**

Ilex paraguariensis contains vitamin B12, B1 and C. *I. paraguariensis* is being used as an anti-dementia agent [61]. Its memory enhancing property was investigated in different rat models [62].

***Nardostachys jatamansi* (Caprifoliaceae)**

Nardostachys jatamansi exhibited memory retention and learning enhancing abilities in aged, young mice, reversed scopolamine and diazepam induced amnesia. *N. jatamansi* also reversed aging and stress induced amnesia [63, 64].

***Magnolia officinalis* (Magnoliaceae)**

Magnolia officinalis improves the scopolamine induced memory deficits [65]. It also inhibits acetyl cholinesterase activity [66]. Ethanolic extract of *M. officinalis* containing honokiol and magnolol has been reported to possess antioxidant effects [67].

***Rosa alba* (Rosaceae)**

Rosa alba produces symptomatic improvement in learning and memory. It might prove to be a useful memory restorative agent in the treatment of cognitive disorders. It reported the effects on cognitive functions learning and memory by using elevated plus maze and passive avoidance test. It also inhibits cholinesterase and improves the memory power [68].

***Celastrus paniculatus* (Celastraceae)**

Celastrus paniculatus increases cholinergic activity that contributes its ability to improving memory performance [69]. Aqueous extract of *C. paniculatus* has antioxidant and cognition enhancing properties [70].

CONCLUSION

In this paper, we reviewed various medicinal plants which showing memory enhancing activity were collected from the different investigations and were reported above as we can say these medicinal plants are responsible for enhance memory function properly under several investigator studied.

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